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MOUNTING METHOD OF PLASTIC SEAL FOR BEARING  
[Jikuuke yo purasuchikku shiru no sochyaku hoho]

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## Claim

A mounting method of a plastic seal for a bearing, characterized by the fact that the plastic seal for a bearing has a fitting portion for fitting with the sealing groove formed on the outer ring of the bearing; for this plastic seal for a bearing, a fastening mold is applied on said fitting portion, and ultrasonic waves are applied to instantly raise the plastic seal to the plastic moldable temperature while fastening is performed, so that said fitting portion is fit in said sealing groove.

## Detailed explanation of the invention

[0001]

Technical field of the invention

The present invention pertains to improvement of the mounting method of a plastic seal for a roller bearing.

[0002]

Prior art

In the prior art, as a roller bearing's seal device, for example, rubber seal (1A) shown in Figure 7 or steel seal (1B) shown in Figure 8 is usually used. Said rubber seal (1A) has rubber (2) heated and attached on the surface of metal core (3) in a donut disk shape with the outer periphery folded to an L shape. On the other hand, steel seal (1B) is made of a donut shape steel sheet with the outer peripheral portion formed to a complicated folded shape as shown in Figure 8.

[0003]

Figure 9 shows the mounting state. For rubber seal (1A), the side of exposed surface (3a) of metal core (3) is taken as the bearing side, the inner peripheral side having the seal lip is arranged facing the side of inner ring (4) of the bearing, and the outer peripheral side is fit in sealing groove (5a) formed on outer ring (5) and is mounted on the end surface of the roller bearing. On the other hand, for steel seal (1B), the outer peripheral portion is fastened by fastening mold (7) so that it is fit in sealing groove (5a) of outer ring (5).

[0004]

Problems to be solved by the invention

Said rubber seal (1A) has a good sealing property. However, because different types of materials are jointed with each other, it has the following problems: (1) it is expensive, and (2) when the elasticity is exploited to fit in sealing groove (5a) of the outer ring, there is a tendency for a certain deformation in the thin outer ring, especially for small roller bearings. This is undesirable.

[0005]

On the other hand, although steel seal (1B) is inexpensive, because steel is a hard material, it has the following problems: (1) the seal performance is not as good as that of the rubber seal, and (2) when fitting is performed in sealing groove (5a) of the outer ring by means of fastening, the circularity of the outer ring becomes larger. Consequently, instead of the conventional rubber seal or steel seal for the roller bearing, a plastic seal has been proposed using plastic material having properties intermediate between those of said materials. Various schemes have been proposed for it.

[0006]

For example, the type disclosed in Japanese Kokoku Utility Model No. Sho 62[1987]-12906 is made of an elastic synthetic resin, the outer peripheral portion is formed in a trapezoidal shape, left/right symmetric with respect to the central line of the thickness, and it is mounted with its slope in elastic contact with the slope of the sealing groove on the outer ring. Also, for the type disclosed in Japanese Kokai Utility Model No. Sho 62[1987]-149622, the same elastic synthetic resin is used to form it; the outer peripheral portion has a nearly V-shaped cross-section having a prescribed neck groove formed on it, and it is mounted by pressing into the sealing groove on the outer ring by means of the V-shape elastic deformation. Also, for the type disclosed in Japanese Kokai Utility Model No. Hei 6[1994]-6752, the engagement portion with the inner ring or the outer ring is formed from a soft resin with a V-cross-sectional shape. In this engagement portion, a ring-shaped disk made of a hard resin is integrally jointed to form a joint structure, and the elastic deformation of the V-shape engagement portion is used to press it in the sealing groove for mounting. In addition, for the type disclosed in Japanese Kokai Utility Model No. Hei 7[1995]-32985, on the inner side surface of the outer peripheral portion of the plastic seal, a protruding portion having a trapezoidal cross-sectional shape is formed in a ring shape, and at the same time, on the outer peripheral edge portion of the seal, a protrusion towards the outer side surface is formed, and the protrusion with said trapezoidal shape contacts with the inner side surface of the sealing groove of the outer ring for jointing, and at the same time, said protrusion is brought into contact with the outer side surface of the sealing groove for mounting.

[0007]

However, for the conventional plastic seals, due to the characteristics of the materials, there is no elasticity similar to that of the rubber. Consequently, even when the shape of the mounting portion is

carefully designed to increase the elastic deformation force, the seal performance still is poorer than that of the rubber seal. This is undesirable. Also, it cannot be fastened as forcibly as the steel seal, so that it may come out from the mounted sealing groove. This problem should be solved. Also, the elasticity is insufficient, and the precision of the sealing groove has to be improved correspondingly. As a result, the cost increases inevitably due to processing of the sealing groove. Consequently, the advantage of a lower material cost than rubber is meaningless.

[0008]

The purpose of the present invention is to solve the aforementioned problems of the prior art by providing a mounting method of a plastic seal for a bearing, characterized by the fact that ultrasonic waves are used to locally heat the mounting portion of the plastic seal so that it can be fit with a high strength to the sealing groove instantly, and while excellent seal performance is displayed, there is little deformation of the outer ring, the operability is excellent and the cost is low.

[0009]

Means to solve the problems

In order to solve the aforementioned problems, the invention described in Claim 1 of the present patent application provides a mounting method of a plastic seal for a bearing, characterized by the fact that the plastic seal for a bearing has a fitting portion for fitting with the sealing groove formed on the outer ring of the bearing; for this plastic seal for a bearing, a fastening mold is applied on said fitting portion, and ultrasonic waves are applied to instantly raise the plastic seal to the plastic moldable temperature, while fastening is performed so that said fitting portion is fit in said sealing groove.

[0010]

According to the present invention, by applying ultrasonic waves generated by an ultrasonic oscillator, with the fastening mold pressed on the fitting portion of the plastic seal for a bearing, locally, the plastic material of the fitting portion is instantly heated to the moldable temperature. Then, by pressing with a small force the softened fitting portion with the fastening mold, it can be deformed easily and fit under pressure into the sealing groove on the inner surface of the outer ring. In this case, ultrasonic waves are used as the heating means, and the finer tapered tip portion of the fastening mold is pressed on the fitting portion while ultrasonic waves are transmitted, so that there is no heating of the remaining portion of the plastic seal and there is thus no thermal deformation of the overall seal. By applying pressure at the same time on the locally heated fitting portion, the fitting portion can be deformed easily, so that it can be pressed to fit in the sealing groove on the outer ring of the bearing. Consequently, it is possible to realize excellent sealing performance, and at the same time, it is possible to realize a strong mounting effect so that fall-off can be efficiently prevented. Also, because no excessive force is applied on the outer ring of the bearing, no deformation takes place.

[0011]

Here, as the material of the aforementioned plastic seal, the engineering plastic material with a high crystallinity is used, and due to the thermal characteristics of the crystalline plastic material (see the thermal behavior curve in Figure 4), when heated to the prescribed temperature, the heated portion is drastically softened. Consequently, this is extremely beneficial for using the ultrasonic waves to carry out localized heating while preventing overall deformation.

[0012]

Also, by forming a protrusion strip seal lip on the bottom surface or side surface portion of the fitting portion on the outer periphery of the seal (the surface contacting the plane surface portion or concave surface portion of the sealing groove of the outer ring), it is possible to further improve the seal performance. Also, by arranging a fitting reference surface on the outer side surface of the seal fitting portion, while arranging the corresponding fitting reference surface on the site on the sealing groove on the outer ring, it is easy to align the plastic seal correctly.

[0013]

#### Embodiment of the invention

In the following, an explanation will be given regarding the embodiment of the present invention with reference to figures. Figure 1 is a half cross-sectional view illustrating plastic seal (10) made of a donut disk shape plastic plate. Its outer peripheral portion is fitting portion (11) fitting with nearly U-shape sealing groove (5a) formed on the inner surface of outer ring (5) of the bearing. It has a nearly V-shape cross section. Outer surface (12a) of edge (12) on the outer peripheral side is a vertical surface facing the recession of sealing groove (5a) as shown in the figure. Bottom surface (12b) is a horizontal surface in a shape that cuts off the top portion of the acute angle of the V-shape portion, and it contacts plane surface portion (5b) of sealing groove (5a).

[0014]

The edge portion of the inner surface of edge (12) on the outer peripheral side is formed as a slope inclined towards the inner side, and this slope becomes fastening-mold-contact surface (13). This fastening-mold-contact surface (13) should be arranged as near to sealing groove (5a) of the bearing as



possible. Figure 2 is a diagram illustrating an example of the fastening mold for embodiment of the mounting method of the plastic seal for a bearing in the present invention. On the tip of fastening mold (15), contact portion (15a) contacting fastening-mold-contact surface (13) of plastic seal (10) is formed in a protruding ring shape. The rear end of fastening mold (15) is connected to ultrasonic oscillator (25).

[0015]

When said plastic seal (10) is mounted on sealing groove (5a) of outer ring (5) of the bearing, first of all, bearing W as the workpiece is laid horizontally, and bottom surface (12b) of plastic seal (10), which is also in the horizontal posture, is carried on plane surface portion (5b) of the sealing groove of outer ring (5). Then, tip contact portion (15a) of fastening mold (15) is brought into contact with fastening-mold-contact surface (13) of plastic seal (10). This state is illustrated by the dot-dash line in Figure 1.

[0016]

In this state, ultrasonic oscillator (25) is turned on. As a result, ultrasonic waves are transmitted via fastening mold (15) from contact portion (15a) to fastening-mold-contact surface (13) of plastic seal (10). As a result, the portion of edge (12) of the outer peripheral side of fitting portion (11) of plastic seal (10) is heated, so that it is instantly heated. The heating degree in this case corresponds to the temperature at which the plastic material becomes soft and moldable as shown in the thermal behavior diagram of plastic material shown in Figure 4. Examples of the plastic materials that may be used preferably for plastic seal (10) in this invention include polyether ether ketone (PEEK), polyphenylene sulfide (PPS), and other so-called super-engineering plastics, polyether, polyamide, and other engineering plastics. Most of them are of a crystalline property. As can be seen from Figure 4, the

crystalline plastic material drastically softens at certain temperatures. Consequently, as the ultrasonic waves are transmitted in a very short time, a portion of edge (12) on the outer periphery of plastic seal (10) is instantly heated to the moldable temperature, so that the thermal deformation of the overall seal can be suppressed. At the same time, fastening mold (15) is lowered to press edge (12) of plastic seal (10), which has been locally heated to soften. As a result, only edge (12) of the plastic seal is deformed so that it is inclined outward. Said edge (12) on the outer peripheral side is opened outward, and the tip is squeezed out from the outer diameter before deformation. As a result, squeezed-out portion (16) fits under pressure in sealing groove (5a). In this case, it is preferred that ultrasonic oscillator (25) and fastening mold (15) be integrated, and heating and pressing be performed simultaneously.

[0017]

Figure 5 is a diagram illustrating the state after mounting of plastic seal (10) using sealing groove (5a) of outer ring (5) of a ball bearing using the aforementioned method. Here, fitting portion (11) of plastic seal (10) is forcibly pressed and fit in sealing groove (5a) of outer ring (5), so that a good sealing can be realized, and at the same time, mounting is realized reliably. As a result, no fall-off can take place.

[0018]

In addition, because it is a molding of plastic material, the cost is lower than that of the rubber seal. Also, because fitting under pressure is performed after heating for softening, outer ring (5) of the bearing has a very small deformation degree. This is another effect of the present invention. In addition, sealing groove (5a) on the outer ring conventionally adopted for the rubber seal and steel seal can be used as it is for mounting, so that the conventional seal-attached outer ring can be used as it is, and there is no need

to manufacture new outer ring with the sealing groove on it. The mounting operation also can be performed easily, the quality can be guaranteed, and the cost can be cut. Consequently, the overall cost cut effect is significant, and it has a major advantage for practical application.

[0019]

Figure 6 shows another example of the embodiment. In this case, it differs from the aforementioned embodiment example in that protruding strip-shaped seal lip (20) contacting plane surface portion (5b) of sealing groove (5a) of outer ring (5) is formed on bottom surface (12b) of the outer peripheral portion of fitting portion (11) of plastic seal (10). Even when a fastening force with the same magnitude as that of the aforementioned is applied, because the sealing pressure for unit sealing area is significantly increased by the sealing lip, the sealing performance is further upgraded. This is an advantage of the present invention. The other operation and effects are the same as those of said first embodiment example.

[0020]

Figure 7 shows yet another embodiment example. In this example, inner peripheral reference surface (21) is formed on the side of sealing groove (5a) of outer ring (5) of the bearing. On the other hand, on the outer side surface of fitting portion (11) on the outer periphery of plastic seal (10), outer peripheral reference surface (22) corresponding to said inner peripheral reference surface (21) is formed. The remaining constitutional features are the same as those in said first embodiment example.

[0021]

As a result, it is possible to improve the concentricity between plastic seal (10) and sealing groove (5a), so that alignment of the plastic seal can be performed easily and correctly. The remaining operation and effects are the same as those in said first embodiment example.

[0022]

Effect of the invention

As explained above, according to the mounting method of a plastic seal for a bearing in the present invention, a fastening mold is brought into contact with the fitting portion in the sealing groove of the bearing, and while ultrasonic waves are transmitted, the fitting portion is locally heated and deformed, and it is pressed to fit in the sealing groove. Consequently, it is possible to ensure that only the fitting portion of the plastic seal is instantly heated by the ultrasonic waves to a moldable temperature at which it can be deformed easily, so that it can be easily fit in the sealing groove. As a result, it can be reliably fit in the sealing groove, and it thus possible to prevent fall-off, and the sealing performance is excellent. In addition, there is little deformation of the outer ring, and the cost also can be significantly reduced. These are excellent effects of the present invention.

#### Brief description of the figures

Figure 1 is a half cross-sectional view illustrating the state of the plastic seal for bearing before deformation in an example of the embodiment of the present invention.

Figure 2 is a partially cut side view of the fastening mold for mounting the part shown in Figure 1.

Figure 3 is a half cross-sectional view illustrating the mounting operation of the method of the present invention.

Figure 4 is a diagram illustrating the thermal behavior of the plastic material.

Figure 5 is a cross-sectional view illustrating the roller bearing with the plastic seal mounted on it using the method of the present invention.

Figure 6 is a cross-sectional view illustrating the main portion in another embodiment example of the present invention.

Figure 7 is a cross-sectional view illustrating the main portion in yet another embodiment example of the present invention.

Figure 8 is a half cross-sectional view illustrating the rubber seal for a bearing in the prior art.

Figure 9 is a half cross-sectional view illustrating the steel seal for a bearing in the prior art.

Figure 10 is a cross-sectional view illustrating the roller bearing having said rubber seal or steel seal in the prior art mounted on it.

#### Explanation of symbols

- 5 Outer ring (of bearing)
- 5a Sealing groove
- 10 Plastic seal
- 11 Fitting portion
- 15 Fastening mold
- 15a Contact portion
- 20 Seal lip
- 21 Inner peripheral reference surface
- 22 Outer peripheral reference surface
- 25 Ultrasonic oscillator

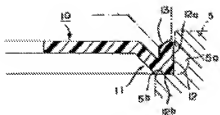


Figure 1

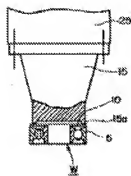


Figure 2

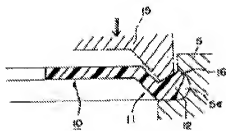


Figure 3

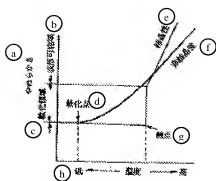


Figure 4

- Key:
- a Softness
  - b Softening region
  - c Moldable region
  - d Softening point
  - e Crystallinity
  - f Non-crystallinity
  - g Melting point
  - h Low ← Temperature → High

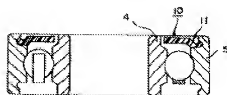


Figure 5

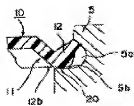


Figure 6